THE SEVERAL FACES OF SCHMORL’S NODE: PICTORIAL ESSAY

INTRODUCTION

The Schmorl node (SN) represents intervertebral disk tissue displaced through the cartilaginous endplate into the vertebral body. These cartilaginous nodes are most frequently observed in the lumbar and lower thoracic spine, a common finding in the general population.1

The detection of SNs on conventional radiographs may be difficult when they are small. However, when a SN is depicted, its radiographic and tomographic appearance is usually typical, with varying focal and small, rounded radiolucency in the subchondral bone of the physis and tomographic appearance is usually typical, with varying focal and small, rounded radiolucency in the subchondral bone of the physis.

When they are small. However, when a SN is depicted, its radiographic and tomographic appearance is usually typical, (Figure 1) with a placa terminal and the consequent hernia of disc intravertebral. The SN is an hallmark frequent in patients asymptomatic, mas pode eventualmente ser acompanhado de sintomas em casos de trauma, espondiloartrite hemisférica, discite calcificada com migração intravertebral, doenças inflamatórias e neoplasias. Embora o NS seja, em geral, associado a doenças benignas, sua presença não exclui a possibilidade de doença maligna concomitante no corpo vertebral. Radiologistas e cirurgiões de coluna devem estar cientes das apresentações menos comuns do NS e dos achados radiológicos relacionados, a fim de evitar erros de diagnóstico.

Keywords: Spine; Intervertebral disc displacement; Radiography; Magnetic resonance imaging.

RESUMO

El objetivo de esta revisión es presentar las características de imagen del nódulo de Schmorl (NS) que ocurren en conjunto con varias etiologías. El NS es un hallazgo relativamente común en imágenes diagnósticas de la columna vertebral. Esta condición suele ser asintomática y su etiología no siempre es clara. Cualquier enfermedad que debilite el hueso subcondral del cuerpo vertebral puede conducir a la ruptura de la placa terminal y a la subsecuente hernia de disco intravertebral. El NS es un hallazgo frecuente en pacientes asintómicos, pero, posiblemente, puede estar acompañado de síntomas en casos de trauma, espondiloartrite hemisférica, discite calcificada con migración intravertebral, enfermedades inflamatorias y neoplasias. A pesar de que el NS se asocia generalmente con enfermedades benignas, su presencia no excluye la posibilidad de malignidad concomitante en el cuerpo vertebral. Los radiólogos y cirujanos de columna deben ser conscientes de las presentaciones menos comunes del NS, así como los hallazgos radiológicos relacionados, a fin de evitar un diagnóstico equivocado.

Descritores: Coluna vertebral; Deslocamento do disco intravertebral; Radiografía; Imagem por ressonância magnética.

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The detection of SNs on conventional radiographs may be difficult when they are small. However, when a SN is depicted, its radiographic and tomographic appearance is usually typical, (Figure 1) with a focial and small, rounded radiolucency in the subchondral bone of the vertebral body, broad-based at the vertebral plateau and with varying degrees of adjacent reactive sclerosis.2 Vacuum phenomena in the intervertebral disc space or within the SN may be seen. (Figures 2 and 3)

Weakening of cartilaginous endplate and subchondral bone, which is believed to lead to SNs, might be related to pathologic conditions such as Scheuermann disease, metabolic diseases and neoplastic disorders in spine.2 A previous study with histologic evaluation suggested that SNs may be the result of ischemic necrosis beneath the cartilaginous endplate and that disc herniation into the vertebral body is a secondary phenomenon.3 SN occurrence has also been linked to trauma and vertebral fractures.4,5 often described as acute SNs, especially in symptomatic cases, which have been associated with acute trauma or microtrauma.4,6 Acute SNs have recently been documented as a rare complication of discography.7 In clinical practice, non-acute SNs are commonly depicted as incidental findings in imaging assessment, and are usually considered idiopathic.

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On magnetic resonance imaging (MRI), enhancement of SNs may be observed after intravenous gadolinium administration in patients with and without back pain. Such enhancement was shown to be present in larger SNs, which are believed to be more frequently associated with surrounding bone marrow edema in patients with back pain, as compared to asymptomatic patients.

The purpose of this review is to present imaging patterns of symptomatic SN caused by different etiologies, including findings on radiographs, computed tomography (CT) and magnetic resonance imaging (MRI).

**TRAUMATIC SNS**

SNs may be the result of acute trauma, as commonly observed in subjects with back pain. Another possible presentation of traumatic SNs includes a large vertebral body cystic lesion associated with focal endplate disruption. This type of presentation may potentially lead to misdiagnosis of more aggressive pathologies, such as infection or neoplasm. Zones of weakness in the endplate cartilage may predispose to SNs following subclinical trauma. In such cases, the trauma episode may not be well documented and the radiologic changes at the discovertebral junction can be atypical and easily misinterpreted as evidence of other conditions. Acute and subacute SNs associated with trauma may exhibit surrounding bone marrow edema pattern on MRI.

**Hemispherical spondylosclerosis or discogenic bone sclerosis with SNs**

Hemispherical spondylosclerosis has been initially described on conventional radiographs as a dome-shaped sclerosis of the vertebral body, being which is broad-based at the discovertebral junction. This term was first used by Dihlmann and degenerative disk disease is considered the most common cause of this condition, though it may also occur in conjunction with infection or metastasis. Before the term hemispherical spondylosclerosis was used, a series of cases thought to be related to subclinical trauma demonstrated a similar pattern of broad-based bone sclerosis in about half of cases. Histopathologic evaluation showed only reactive granulation tissue and microscopic bone fragments. CT with multiplanar reconstructions may be useful to identify small SNs that may be associated with reactive subchondral broad-based bone sclerosis. (Figures 5 and 6)

**Calcific discitis with intravertebral migration**

Calcification of the intervertebral disk represents a common incidental finding on radiographic examination. Painful discal calcifica-
tion has been more often reported in the pediatric population and symptoms may eventually include torticollis, fever, leukocytosis and elevation of erythrocyte sedimentation rate. The cause of calcific discitis in childhood is not known, and the prognosis is excellent since pain resolves in a few days or weeks, in most cases, with conservative treatment. Acute calcific discitis may rarely involve the adult population. On radiographs, symptomatic calcifications typically involve the nucleus pulposus and the cervical spine. Such disk calcifications may migrate into the vertebral bodies following a SN, often associated with adjacent reactive bone sclerosis. Other sites of migration include the intervertebral foramina, the spinal canal, and the adjacent soft tissues. More recently, the MRI features of calcific discitis were described, including disc swelling and bulging in early stages, which may be seen before calcifications are visible on plain films. Furthermore, signal intensity changes may occur within the adjacent vertebral bodies.

**Vertebral metastasis with SNs**

Any disorder that weakens the vertebral body subchondral bone may lead to endplate disruption and intravertebral disc herniation. The association between SN and vertebral metastasis has been described in cadavers with prostatic cancer. Vertebral metastases from other primary neoplasms may also be seen in conjunction with SNs. (Figures 8 and 9)
Inflammatory/infectious diseases with SNs

Weakening of the endplate and SNs may be sporadically related to infectious spondylodiscitis (Figure 10) and to other inflammatory spine diseases, such as ankylosing spondylitis.16 (Figure 11)

Figure 9. 35-year-old man with back pain and biopsy-proven thymus carcinoma vertebral metastasis. (A) Sagittal T1-weighted MRI after intravenous gadolinium administration showed pathologic bone marrow enhancement adjacent to SNs at the superior T2 endplate and the inferior L2 endplate (arrows). A nodular metastasis is also observed at L5 (arrowheads). (B) Sagittal T2-weighted MRI demonstrated pathologic fractures associated with SNs at the superior T2 endplate and the inferior L2 endplate (arrows).

Figure 10. 11-year-old girl with low back pain and spine infection. Percutaneous biopsy with a positive culture proved Staphylococcus aureus spondylodiscitis. (A to C): initial MRI. (D): 6-month follow-up MRI. A) Sagittal T2-weighted MRI depicted a SN (arrow) at the superior endplate of the L3 vertebra and adjacent bone marrow edema-like changes (arrowhead). Fat-suppressed sagittal, B) and axial, C) T1-weighted MRI after intravenous gadolinium administration also showed the SN (arrow), with diffuse marrow enhancement in the L3 vertebral body. Note the paravertebral inflammatory collection, consistent with an abscess (arrowheads). C) D) T2-weighted sagittal MRI obtained 6 months later demonstrated destruction of the discal space associated with SNs in both adjacent plates (arrowheads).

Figure 11. 39-year-old man with ankylosing spondylitis (AS) and low back pain. Biopsy was necessary to rule out infection since destructive and inflammatory changes were observed. Changes were progressive in L5-S1 discovertebral transitions; the biopsy addressed this region. Sagittal T2-weighted fat-suppressed (A) and T1-weighted (B) MRI with arrows pointing at a small SN at the superior endplate of S1 and a larger SN at the L5 endplate. (C) Sagittal T1-weighted fat-suppressed MRI after intravenous administration of gadolinium showed inflammatory peripheral enhancement at the SNs (arrows).

FINAL CONSIDERATIONS

SNs represent a relatively common finding in spinal imaging. This condition is usually asymptomatic and its etiology remains unclear. Even though SNs are almost always related to benign pathology, its presence does not exclude the possibility of concomitant malignant disease in the vertebral body. Radiologists and spine surgeons must be aware of uncommon conditions that might be associated with SNs, as well as related radiological findings, in order to avoid misdiagnosis.

All authors declare no potential conflict of interest concerning this article.

REFERENCES